U.S. EPA Environmental Technology Verification Program
Advanced Monitoring Systems Center

Water Stakeholder Committee Meeting

October 4 and 5, 2001
Coeur d'Alene, Idaho

Meeting Minutes

ATTENDEES

Stakeholder Committee Members:

John Carlton, Alabama Department of Environmental Management, Mobile, AL
Dennis Goldman, Longmont, CO
Christine Kolbe, Texas Natural Resource Conservation Commission, Austin, TX
Marty Link, Nebraska Department of Environmental Quality, Lincoln, NE
Patricia McGlothlin, Colorado Springs Utilities, Colorado Springs, CO
Alan Mearns, National Oceanic and Atmospheric Administration, Seattle, WA
Kerry St. Pe, Barataria-Terrebonne National Estuary Program, Thibodaux, LA
Vito Minei, Suffolk County Department of Health Services/ Peconic National Estuary Program, Hauppauge, NY
Richard Sakaji, California State Department of Health Services, Berkeley, CA
Roy Spalding, University of Nebraska, Lincoln, NE
Peter Tennant, Ohio River Valley Water Sanitation Commission, Cincinnati, OH

Observers:

Darren Brandt, Idaho Department of Environmental Quality, Coeur d'Alene, ID
Kathryn Carpenter, URS Corporation, Seattle, WA
Scott Fields, Coeur d'Alene Tribe, Plummer, ID
Steve Gill, TerraGraphics Environmental Engineering, Inc., Moscow, ID
Jerry Lee, TerraGraphics Environmental Engineering, Inc., Moscow, ID
Jim Stefanoff, CH2MHill, Spokane, WA

EPA/Battelle AMS Center Staff

Sheila Eckman, U.S. EPA Region 10, Seattle, WA
Bob Fuerst, U.S. EPA, Research Triangle Park, NC
Elizabeth Hunike, U.S. EPA, Research Triangle Park, NC
Tom Kelly, Battelle, Columbus, OH
Jeff Myers, Battelle, Columbus, OH
Todd Peterson, Battelle, Seattle, WA

Guest Speakers:

Philip Cernera, Coeur d'Alene Tribe, Plummer, ID
Roy Cullimore, Droycon Bioconcepts, Regina, SK, Canada
Geoff Harvey, Idaho Department of Environmental Quality, Coeur d'Alene, ID
Roy Mink, Idaho Water Resources Institute, University of Idaho, Moscow, ID
Barbara Seiders, Pacific Northwest National Laboratory, Richland, WA
Paul Woods, USGS, Boise, ID

October 4, 2001

OPENING SESSION: WELCOME, AGENDA AND MEETING OBJECTIVES

Robert Fuerst, EPA/ETV Advanced Monitoring Systems (AMS) Center program manager, welcomed stakeholders and observers. He expressed his appreciation for the contributions stakeholders are making to the ETV program.

Todd Peterson, facilitator of the ETV AMS Center's Water Stakeholder Committee reviewed the agenda and the meeting's objectives:

- Provide an update on the ETV program
- Describe the status of water technologies undergoing verification
- Learn about water quality monitoring activities and challenges in the Coeur d'Alene River watershed and in Idaho
- Consider next technologies to verify

STAKEHOLDER INTRODUCTIONS

Mr. Peterson invited stakeholders, guest speakers, and observers to introduce themselves and to identify their professional affiliations.

Stakeholder Pat McGlothlin of the Colorado Springs Water Utility mentioned the importance of water rights along the front range of the Rockies in Colorado and the role that multiparameter water quality probes might play in protecting and monitoring water quality and water rights.

Water Quality Monitoring in the Coeur d'Alene Mining District and the Coeur d'Alene River

Paul Woods, a hydrologist and limnologist with the U.S. Geological Survey (USGS) in Boise, Idaho has been monitoring the water quality of the Coeur d'Alene River and Coeur d'Alene Lake since the early 1990's.

The Coeur d'Alene River drains the area surrounding the Coeur d'Alene Mining District. Starting in the late 1800's, silver, gold and lead ores were mined intensively in the district and processed in smelters near the Coeur d'Alene River. Today the smelters have been closed and partially dismantled and many of the mines are no longer in operation. However, groundwater percolating through geologic strata picks up concentrations of zinc, lead and other metals and flows from inactive mines (adyts) into the Coeur d'Alene River, its tributaries and Coeur d'Alene Lake.

There are a number of Federal programs related to water quality in Coeur d' Alene River watershed including:

- Superfund (CERCLA) – The Bunker Hill Superfund Site is the nation's second largest. This Superfund listing addresses the environmental/water quality impacts of hard rock mining principally for silver, gold and lead.
- Natural Resources Damage Assessment - Federal trust resources throughout the Coeur d'Alene River Basin have been damaged. Water quality monitoring is being conducted to assess these damages and to plan remediation.
- Total maximum daily loads - TMDLs are under development for metals, nutrients, and sediment in the Coeur d'Alene River watershed.
- North American Water Quality Assessment- The US Geological Survey is conducting water quality monitoring of the Coeur d'Alene Basin as part of this assessment in the Northern Rockies.
- Remedial Investigation/Feasibility Study – Water quality is being monitored to identify the release, fate and transport of contaminants.

USGS in coordination with the Idaho Department of Environmental Quality and U.S. EPA conduct monitoring. Paul Woods said the monitoring partners were doing more real-time data transmission, transmitting water quality data by satellite every 15 minutes.

Monitoring shows dissolved concentrations of cadmium from 5 to 80 micrograms per liter (ug/L), of lead from 30 to 140 ug/L and of zinc from 850 to 14,000 ug/L in the east Fork of Nine Mile Creek, a tributary of the Coeur d'Alene River. Downstream at Rose Lake, below the former Bunker Hill Smelter complex ("The Box"), monitoring shows dissolved concentrations of cadmium from less than 1 to 2.5 ug/L, of lead from1.5 to 6 ug/L and of zinc from 77 to 530 ug/L. Paul Woods said that 50% of loadings of metals in the river come from the Box. For water year 1999 (October to September) monitoring showed total lead concentrations of from 12 to 880 ug/L per liter in the South Fork of the Coeur d'Alene River at Pinehurst, Idaho. As the discharge rate increases the concentration of particulate constituents of metallic contamination increases. The monitoring agencies track physical and biological evidence of concentrations of metals in

the Coeur d'Alene River's banks and beaches. They also monitor stream flow (daily mean discharge in cubic feet per second).

Paul Woods said sampling needs to take into account diurnal effects. Temperature and acidity may vary as much as six a factor of six depending on the time of day.

He said a LIDAR survey of the lower Coeur d'Alene Basin is needed in order to develop a sediment transport model.

Concentrations of metallic contaminants vary seasonally, with higher concentration washing down stream with early spring run off. For example, a total of 2,550 pounds per day of lead in the flow of the South Fork of the Coeur d'Alene River at Silverton, Idaho was extrapolated from a sample taken at 1300 cubic feet per second (CFS) during a rising flow of spring runoff (May 24, 1999).

Because particulate constituents concentrate at lower depths than dissolved constituents, the agencies conduct cross-sectional, depth-integrated sampling.

USGS is also using a multiparameter water-column instrument to monitor water quality in Coeur d'Alene Lake. The instruments monitors depth, temperature, specific conductance, pH, oxygen reduction potential, dissolved oxygen concentration, dissolved oxygen saturation, PAR, percentage of light transmission, fluorescence and density. Monitoring of lake sediments has revealed waveforms caused by the Great Missoula Floods during the last Ice Age.

USGS is taking sediment cores from a number of locations throughout the lake. Analysis of these samples shows a mean concentration of 3600 ppm of zinc in surface sediments in Coeur d'Alene Lake and a concentration of 1900 ppm for lead in surface sediments.

Verification Status: Arsenic Test Kits

Tom Kelly of Battelle provided an update. Dr. Kelly said that the World Health Organization (WHO) is seeking arsenic detection devices particularly for use in India and Bangladesh, where 70 million people are in danger from poisoning from arsenic in drinking water. WHO is seeking rapid, easy to operate devices capable of detecting arsenic at a provisional guideline value of 10 ppb.

Dr. Kelly reported that four technology vendors have signed up to participate in the verification. These vendors, and their technologies, are:

Envitop (AsTop Arsenic Test Kit)
PETERs Engineering (PeCo As tester)
Trace Detect (Nano-Band Explorer)
International Test Systems (Test Strip).

Dr. Kelly described the principle behind the operation of each testing device. He said the verification tests are scheduled for November, and will be conducted at sites in Ohio where there are two counties with serious arsenic contamination in well water.

Monitoring Contaminated Sediments in Coeur d'Alene Lake

Philip Cernera of the Coeur d'Alene Tribe discussed water quality and environmental monitoring in the Coeur d'Alene Basin including the sediments of Lake Coeur d'Alene. Lake sediments have been contaminated by metals, principally zinc, lead, and cadmium from the Coeur d'Alene Mining District. The tribe, whose claim to the ownership of the southern part of the lake was upheld in 2001 by the Supreme Court, is involved in a Natural Resources Damage Assessment law suit concerning liability for environmental remediation and natural resource damages related to mining in the Coeur d'Alene Basin.

Mr. Cernera said that a century of mining has damaged natural resources in the Coeur d'Alene Basin including surface and groundwater, fish, waterfowl and other biota, aquatic vegetation, sediments and macroinvertebrates. The Coeur d'Alene Tribe in cooperation with state and federal agencies conducted an assessment of damage to natural resources. The tribe initiated the Natural Resource Damage Assessment (NRDA) in 1991, and was subsequently joined in this effort by the U.S. Department of the Interior and the U.S. Department of Agriculture. In conjunction with the Idaho Department of Environmental Quality and U.S. EPA, the tribe oversaw the initial remediation ("inside the Box") of 21 square miles around the Bunker Hill site. At this time, the state of Idaho, the Coeur d'Alene Tribe, and U.S. EPA have initiated the Coeur d'Alene Restoration Project, a $350 million to $1.5 billion effort over the next 30 years to cleanup the Coeur d'Alene Basin. A significant part of this effort will be the development of a plan for monitoring, which will validate progress toward reaching remediation goals.

The Coeur d'Alene Tribe is tracking the EPA cleanup program. EPA has discretion to set the parameters of the clean up. The natural resource trustees, such as the tribe, have the ability to go after additional funds for cleanup above levels set by EPA.

Starting in 1991, the tribe participated in 30 studies to gather data (and fill in data gaps) concerning the effect of metallic contamination on the natural resources of the Coeur d'Alene Basin. Those studies included characterizing sediment contamination and water quality throughout the basin. Tribal monitoring and assessment started with characterizing sediment contamination and moved up the Coeur d'Alene River. The tribe was assisted in this effort by the Idaho Department of Environmental Quality and the USGS. Of particular value has been USGS's innovative monitoring of the benthic flux of metals from lake sediments. Mr. Cernera estimated that there are 75 million tons of contaminated sediments in Lake Coeur d'Alene. The tribe operates 13 water quality-monitoring stations in the southern part of the lake. He said 95% of sampling results exceed allowable concentration levels for zinc. Zinc has suppressed the growth of phytoplankton in the lake. The tribe has also inventoried all the streams of its reservation and is monitoring the migration of ad fluvial bull trout and cut throat trout. Mr. Cernera said that fish avoid waters with high concentrations of zinc.

As part of preparing the NRDA suit, the tribe extensively analyzed natural resource data including data on surface and groundwater. Mr. Cernera said that 80 – 90% of the river basin/flood plain has readings of 1800 ppm or above of lead. He said that this level of lead kills birds. He said a 90-95% reduction in metallic input at every site is needed to achieve environmental standards.

The tribe, the Idaho Department of Environmental Quality, and USGS have developed a lake management plan, which involves intensive monitoring over the next few years.

At this time the tribe is focusing on monitoring metallic contamination in fish tissue and the remobilization of metals out of lake sediments (benthic flux). Anaerobic/anoxic conditions in lake water facilitate the remobilization of metallic contaminants in sediments. Under these conditions, dissolved metals move up the water column until they encounter oxygenated water, at which point they reprecipitate. Therefore, a significant part of the Coeur d'Alene cleanup is controlling non-point sources of nutrients that create biological oxygen demand.

Mr. Cernera said that in terms of water quality monitoring technology, what's really needed is a rapid, inexpensive, durable, practical method of monitoring and analyzing metals remobilization from sediments.

Paul Woods commented that the time is right to come together to develop a monitoring plan for the Coeur d'Alene Basin that the scientists, politicians ands the public can agree to. He asked, "How do we reach agreement on monitoring this basin?"

Water-borne Pathogen Detection

Since first convening four and a half years ago, the ETV AMS water stakeholder committee has recommended the identification, and if possible, the verification of rapid pathogen detectors. Although to date no commercially ready, rapid detection devices have been identified, the need remains high on the list of stakeholders' priorities.

Dr. Barbara Seiders of the Pacific Northwest National Laboratory titled her presentation to the committee, "Water-borne Pathogen Detection. Or why don't we have technologies to verify?"

Dr. Seiders said that even for highly sensitive detection systems, large sample volumes must be "interrogated" for statistically meaningful results, especially for low-copy targets in the original sample. She described biological detection as a process involving sample collection, filtration and concentration, cell growth or induction, lysis, either protein/antigen or nucleic acid processes and target amplification. Uncertainties occur at a number of places in this process.

Integrated biodetection involves sample concentration and lysis, nucleic acid concentration and purification, amplification and detection. Sample processing is the limiting technology.

Dr. Seiders described the Idaho Technology R.A.P.I.D System (Ruggedized Advanced Pathogen Identification Device). The system features automated running and analysis software, freeze-

dried reagents, and "real-time reach-back capability." Samples are transferred to reaction cuvettes and placed in the R.A.P.I.D. instrument for thermal cycling. DNA is extracted from the sample. Necessary reaction components are:

The target DNA
DNA polymerase
Free nucleic acids
Primers
Fluorescent probes
Magnesium buffer
Enzyme diluent
Sterile water.

Reagents need to be refrigerated or frozen and cannot survive multiple freezing and thawing. More information about the R.A.P.I.D. system is available on the Web at www.idahotechnology.com

Dr. Seiders outlined "integrated bio detection" at the Pacific Northwest National Laboratory. She described microarrays for environmental microbiology including;

- Pathogen detection and genotyping in environmental samples, including water
- DNA "fingerprinting" of bacterial pathogens
- Microbial community profiling
- Ecotoxicity
- Expression profiling
- Planar and suspension arrays.

She depicted multi-dimension biochip spectral analysis and Matrix Assisted Laser Desorption Ionization (MALDI) Time of Flight (TOF) Mass Spectrometry (MS).

MALDI TOF MS accurately, rapidly identifies microorganisms by mass spectra. Microbial cells can be characterized, often without sample preparation. Bacteria can potentially be identified by reproducible genus-, species-and strain-specific, statistically generated "fingerprints" of key biomarkers. This process offers the potential to monitor biological health hazards related to water, food, blood, and diseases.

Dr. Seiders discussed the "construction" of bacterial fingerprints for such disease indicators as *E. Coli* through automated spectral interpretation. She said that a fingerprint extraction technique works on mixtures and multiple analytes. A statistically based analysis of MALDI-MS generates a list of peak values that can provide additional information or may be submitted to a database search.

In terms of detecting intact bacteria with MALDI-MS, a replicate study showed good reproducibility of peak vales of major ions, typically within 2 Daltons. Different genera of bacteria displayed distinct fingerprints. Sixty replicate spectra are necessary at a minimum for library development. Experimental parameters including matrix, solvent, and MALDI spot

preparation must be consistent for library development. Internal calibration is essential for reliable peak values. Recent research demonstrates the potential for using MALDI MS for monitoring chemical contaminants as well. The process uses organophosphorous simulants for nerve agents. Gentle ionization provides simple spectrum of chemicals.

Dr. Seiders said that the reasons we don't have MALDI MS laboratory-based capability are that we still need a library of fingerprints of pathogens of concern, less expensive spectrometers, and a sample collection and concentration protocol. For a field capability, we need a linkage of continuous sample collection and concentration with the MALDI MS system and a "fieldable" spectrometer.

Questions on biodetection research and MALDI MS pathogen detection should be directed to Barbara.Seiders@pnl.gov (509) 372-4225.

Water Quality Monitoring: A State Perspective

Geoff Harvey of the Idaho Department of Environmental Quality provided a state perspective on water quality monitoring in the Coeur d'Alene Basin. He said that agency managers, politicians, members of environmental organizations, and regulated enterprises all have high expectations for water quality monitoring. The results sometimes disappoint these stakeholders.

In the Coeur d'Alene Basin, water quality monitoring is implemented to assess:

- Trends in water quality such as concentrations of zinc in river and lake water. (Monitoring showed a mean of 60 ug/L of dissolved zinc in Coeur d'Alene Lake water in 2000.)
- The magnitude of pollutant loads (metals) and the location of their origin
- The impact of those metals on sensitive beneficial uses (biomonitoring)
- The effectiveness of remedial projects
- Discharge monitoring to assess the impact of traditional point sources.

At the heart of water quality monitoring in the Coeur d'Alene Basin has been the collection of integrated water samples and measuring discharge. Often discharge has been measured continuously. Samples go to a certified lab for analysis. In addition, point source dischargers have collected effluent samples for laboratory analysis, and now also make in-stream measurements. A recent trend is a beneficial use monitoring team measuring macroinvertebrates, fish population structure and density, and a range of parameters concerning in-stream habitat. Some of these samples, notably macroinvertebrates, go to a laboratory for analysis.

Dr. Harvey said that the data now collected are allowing the development of more specific and comprehensive information than in the past. The data are also revealing limitations of methods

and policies. Traditional discharge monitoring records have been of little use except to develop load contributions and limitations in TMDLs. Other data, if available, were relied on to assess the impacts of a discharge. A few years ago, in-stream monitoring was required, but bio monitoring was confined to WET tests with biota not native to the Coeur d'Alene Basin. Currently the northern region of the Idaho Department of Environmental Quality, in its permit certifications, is requiring regular monitoring upstream and downstream of discharges.

Dr. Harvey reported that column and biomonitoring could also expose problems with monitoring methods and standards. A good local example is monitored zinc concentrations when compared to biomonitoring results. Fish age class structures and density as well as assemblages of macroinvertebrates similar to those found in control areas can be found in areas where dissolved zinc concentrations are three to seven times the standard. Where organic carbon is prevalent in the water, concentrations can reach 10 times the standard. The explanation appears to be in part the adaptation and acclimatization of fish and macroinvertebrates to metals. However, Dr. Harvey said, further analysis reveals a weakness in measurements. "We measure dissolved zinc as those zinc chemical species that pass a .45 micron filter. Yet many zinc species, many chelates of organic material, will pass through a .45 micron filter." It is the zinc ion that primarily affects the gills of fish and macroinvertebrates. "We are attempting to manage with very imprecise information," he said. "The science needs improvement." What is needed is a zinc specific ion electrode. A prototype has been developed by Ivan Linscott at the Stanford Research Institute (SRI) in Palo Alto, California. Such a monitoring technology, Dr. Harvey said, "might greatly alter our view of water quality impairment."

Deploying Multiparameter Water Probes in Long Island Sound

Vito Minei, P.E., a member of the stakeholder committee of the Environmental Technology Verification, Advanced Monitoring System Center discussed the vicissitudes of deploying multiparameter water quality monitoring probes in Long Sound. Mr. Minei is Director of the Division of Environmental Quality of the Suffolk County, New York Department of Health Services. He is also Director of the Peconic National Estuary Program.

Mr. Minei reported that all embayments in Suffolk County, which covers all of central and eastern Long Island, are sampled either once or twice a month. The following parameters are monitored:

- Nitrogen (NH_3, NO_3, Urea, TKN, DKN)
- Phosphorus (TPO_4, TDPO4, O-PO_4)
- *Aureococcus*
- Temperature
- Carbon (TOC, DOC)
- Coliforms
- Secchi depth
- Dissolved oxygen
- Salinity
- Chlorophyll-A
- Pesticides
- VOCs

1999-2000 saw a mass die-off of lobsters in Long Island Sound. Economically, this is the most important fishery in New York State. Seven million pounds of lobsters were landed in 1998;

three million pounds were landed in 2000. Several theories as to the cause of the die off were advanced including: paramoeba, toxics, and environmental stresses. The die off generated intense interest in water quality monitoring. Suffolk County deployed in Long Island Sound two YSI continuous monitoring buoys with the purpose of tracking dissolved oxygen, temperature, and salinity, investigating possible associations between environmental stresses and lobster mortalities.

The monitoring buoy provided the benefits of continuous, real-time data to assess water quality and inform researchers and managers. The monitoring buoy presented challenges in terms of cost, anchoring difficulties, deployment, retrieval and maintenance. Biofouling was also an issue as was the need for a large boat to maintain and retrieve the buoy.

Verification Status: Multiparameter Water Probes

Jeff Myers of Battelle provided an update on the verification of this category of technology. ETV/Battelle is working with the National Oceanic and Atmospheric Administration (NOAA) to conduct the verification test of multiparameter probes at NOAA's Center for Coastal Environmental Health and Biomolecular Research (CCEHBR) near Charleston, South Carolina. The verification test will be conducted in the spring of 2002 over a period of approximately two and a half months. CCEHBR offers freshwater, salt water, and a controlled site for testing the monitoring technologies under varying conditions. The freshwater site for the verification is large relatively shallow ponds that receive nutrient and pesticide loadings from non-point source runoff from land uses.

Charleston Harbor is the saltwater site. The harbor is tidally dominated but receives some riverine fresh water. Nearby land uses include residential, industrial, commercial uses and dredge spoil storage.

The controlled site or "mesocosm" is a tank containing elevated sediment trays and stream channels. The trays contain sediment, salt marsh vegetation, and benthic communities. Twice daily, seawater is pumped in to simulate a flood tide.

The verification test will assess the technologies' ability to monitor dissolved oxygen, pH, temperature, nitrate, phosphate, chlorophyll, turbidity, and conductivity. The tests will calculate the instruments' range, linearity, accuracy, precision, and resolution.

At the salt and fresh water sites, the verification will involve one month of field deployment of the probes with intensive sampling (every half hour for eight hours) for reference analyses at the start and end of that period. The verification will run for one week in the controlled environment, with four samples daily.

General Oceanics, Horiba, Hydrolab, and YSI are the participating technology vendors.

Water Quality Monitoring in Idaho

Dr. Roy Mink of the Idaho Water Resources Research Institute at the University of Idaho provided an overview of water monitoring in Idaho. Idaho is in the upper Columbia River Basin, a regional watershed delineated by the Columbia River system.

In 1990, sampling began at 56 surface water sites in the state. The samples are analyzed for chemical constituents and, starting in 1996, for biological constituents. Between 1993 and 1996 more than 2,000 sites on the state's rivers and streams were monitored. Since 1997, another 2000 sites have been added.

The principal sources of information about the quality of the state's groundwater are the statewide monitoring network (consisting of 1,500 wells) and routine monitoring of public drinking water systems. Of the 1500 wells, 400 are sampled annually. Sites are sampled at least once every four years.

Groundwater pollutants of concern in the Panhandle basin that includes the Coeur d'Alene River watershed include:

Volatile organic compounds
Pesticides
Nitrates
Semi-volatile organic compounds such as pentachlorophenol
Inorganics/metals from the Bunker Hill mining area:
- Lead
- Zinc
- Cadmium.

Surface water pollutants and conditions of concern in the Panhandle basin include:

Sediments
Nutrients
Temperature
Metals.

Dr. Mink discussed destructive sampling and leach tests to analyze the quality of riverbank pore water. Toxic characteristic leaching procedure (TCLP), synthetic precipitation leaching procedure (SPLP), and lysimeter samples were used to compare the ability of soil remediation technologies to sequester lead and zinc. Dr. Mink cited conclusions to date:

- Lysimeter samples were more defensible than TCLP and SPLP
- Beware of spatial variability
- No information is available on the form of the lead and zinc available, or how remedial technologies removed either from the dissolved fraction
- TCLP and SPLP may not extract a particular phase that may otherwise be available for plants, animals or transport.

Finally, Dr. Mink briefly described work being done by scientists at the University of Idaho and USGS to monitor metals flux from lake sediments to a lake's water column such as is occurring in Coeur d'Alene Lake. Researchers are collecting depth-stratified samples of pore waters from sediments. Results will be used to model the movement of metals into the water column.

Future Technology Verification Priorities

Stakeholders recommended the following for possible verification:

- Rapid pathogen detectors including on-line particle counters, on-line *Giardia/Cryptosporidium* detection and rapid bacterial detection, for example for detecting *E. Coli* with the ability to distinguish the source of the coliform
- Ion-specific probes for zinc, lead, cadmium, copper
- Groundwater velocity meters
- Down-hole, real-time sensors
- Instruments to detect endocrine disruptors and pharmaceuticals
- Devices to measure the cycling of Carbon 13
- On-line phosphate and nitrate monitors with accurate (low) detection limits: a chemical analyzer, not an electrode
- Bio-markers/tissue samplers.

Stakeholder Alan Mearns recommended reporting the beneficial results of the ETV program in the ETV AMS newsletter, *The Monitor*. Stakeholder Rick Sakaji suggested that the ETV program tie in with state technology certification programs so that certification by one state could lead to certification elsewhere. Stakeholder Vito Minei suggested that the U.S. Army and the U.S. Navy be approached to underwrite the verification of multiparameter probes.
Stakeholder John Carlton described the Navy – US EPA collaboration going on with the Gulf of Mexico program.
Stakeholder Alan Mearns pointed to the value of the national monitoring tools list.

AMS Center/ETV Program Update

Tom Kelly of Battelle reported that the ETV program has a new director at EPA. Teresa Harten has assumed leadership of the program from Penny Hansen who retired.

This year, Dr. Kelly said, the ETV program has seen a change from 12 pilot projects to six centers, including the Advanced Monitoring Systems Center of which the verification of water quality monitoring technology is part. Three pilot projects have been discontinued. These are EVTEC, Indoor Air, and the California Pollution Prevention pilot projects. Three National Sanitary Foundation pilots – wet weather flow, drinking water and source water protection - have been consolidated into one ETV center. 2002 will see the rebidding of the contract for the pollution prevention center.

Dr. Kelly said that the ETV program has signed a memorandum of agreement with the State of Massachusetts to participate in ETV activities. The program's cooperation with NOAA may also result in a MOA. This cooperation is evident in shared planning for the verification of multiparameter water quality probes at NOAA facilities in Charleston, South Carolina in the spring and summer of 2002.
In addition, ETV is responding to international interest in starting similar technology verification programs. In September, ETV program representatives, including Adam Abbgy of Battelle, traveled to India to discuss the formation of a program in that country.

The ETV program, Dr. Kelly said, has completed the verifications of 164 technologies. The Advanced Monitoring Systems Center completed 21 verifications this year and 35 since the program's inception.

Friday October 5

Investigating Microbial Communities

Dr. Roy Cullimore of the University of Saskatchewan and Droycon Bioconcepts described a patented test system for the determination of aggressivity in bacterial communities. ("Aggressivity" is a measure of the ability of a bacterial community to invade a defined environment.) Dr. Cullimore pointed out the importance of investigating bacterial communities (called consorms) because of their effect on the sustainability of water wells and their control of many environmental processes. (A consorm is a community of bacterial species all functioning cooperatively in a common habitat.) Dr. Cullimore critically examined the concept that a single microbiological species is responsible for any disease. He said that the impact of consorms on health and industrial and agricultural activities is not fully understood. His research has led him to write *The Practical Atlas for Bacterial Identification.* His mapping of microbiological species has shown him, for example, that *Coliforms* are spread through a number of genera of bacteria and do not involve just *Escherichia coli.*

Health issues related to water and water monitoring inevitably involve the coliforms. Dr. Cullimore reported that in the period 1991 to 1998, 38% of water borne disease outbreaks in the U.S. were acute gastrointestinal illnesses of unknown cause. Twenty-two percent of outbreaks were caused by parasites, 19% were caused by chemical agents, 17% by bacterial agents and 4% by viral agents. In the same period, 67% of waterborne disease outbreaks could be attributed to wells, 22% to surface water sources, 7% to springs and 4% to other sources.

Dr. Cullimore described estimating the aggressivity of a bacterial consorm by measuring the time before a reaction to that specific consorm in a patented procedure (the Biological Activity Reaction Test - BART™ test). (If a high level of precision is required the time lag would need to be measured using a spectrophotometric monitoring system.) A particular consorm will generate a particular "reaction pattern signature." The biological activity reaction test is applicable to determine specific microbial consorms that can create risks or offer solutions. The

test determines how aggressive the selected bacterial consorm is and which bacteria dominate a sample.

Dr. Cullimore explained how the BART™ works. He compared this test with agar-plate based approaches. He said that the consequence of restrictions created by using agar spreadplates is that many bacterially driven events are explained as being chemical or of unknown origin.

Dr. Cullimore said that the biological activity reaction test can detect sulfate reducing and iron related bacteria. BART™ testers have been used in extreme environments such as to measure microbiological activity on the Titanic.
The testers detect heterotrophic aerobic bacteria and have applicability to testing biological oxygen demand. This oxygen demand is measured by the respiratory activity of the microorganisms in the sample being tested.

In discussing a comparison between the BART™ BOD measuring system and the standard five-day BOD test, Dr. Cullimore said that the five-day BOD standard test has greater precision for primary waste waters and the BART™ BOD system has equal or greater precision for secondary and tertiary effluent.

Dr. Cullimore also discussed the development of a biological activity reaction time test system for the detection of either fecal or total coliform.

Field Trip to the Coeur d'Alene River Watershed

Geoff Harvey of the Idaho Department of Environmental Quality, Paul Woods of USGS and Roy Mink of the Water Resources Institute of the University of Idaho led a field trip to the Coeur d'Alene River watershed. The purpose of the field trip was for committee members to see first hand the causes, monitoring, and remediation of metals in the Coeur d'Alene River and the river's riparian zone.

The committee first stopped at Canyon Creek, a tributary of the South Fork of the Coeur d'Alene to examine a system for the semi-passive treatment of metals in groundwater flowing from abandoned mine shafts (Helena-Frisco and Black Bear mines). A mining company representative explained the operation of the treatment system. The pilot scale system will be operated for three years under an Administrative Order of Consent signed by EPA. The pilot system is designed to treat 10 to 20 gallons per minute of groundwater coming from the east side of the Canyon Creek drainage.

The pilot system includes:

- An energy dissipation structure at the end of the pipeline that conveys water into the treatment system
- A pretreatment oxidation/settling pond to precipitate metal hydroxides and other suspended solids from the drainage
- Two sand filters
- Two biological treatment cells.

After flowing through the pretreatment pond, flow is split between the two treatment cells. The first treatment cell is a compost bioreactor designed to remove metals from mine waters passively. The lined cell is filled with a substrate comprised of sawdust, manure, alfalfa and gravel. The compost materials provide an organic carbon food for indigenous sulfate reducing bacteria that convert sulfate in the mine drainage to sulfide. The sulfide then complexes with metal cations in the drainage water (i.e. zinc, cadmium) to form low solubility metal sulfide complexes. The metal sulfide complexes precipitate from the water column within the cell thus reducing metal concentrations in the effluent water.

The second cell is a gravel bioreactor designed to remove metals from the mine drainage semi-passively. The second cell is identical to the first except that the substrate is comprised of clean gravel. An external source of soluble organic carbon is fed into the cell's influent water to sustain sulfate-reducing bacteria.

Water flowing in and out of the treatment cells and between each of the system components has been sampled monthly since April 2001. Water samples are tested for a suite of metals, major constituents, and physical parameters to assess the performance of the treatment systems.

Water sampling shows sulfate concentrations decrease dramatically through the cells (especially the second cell) and alkalinity concentrations increase indicating that sulfate reduction is occurring. Sampling results also show significant reductions in zinc and cadmium concentrations through the treatment system as a result of metal sulfide precipitation. Conversely, concentrations of certain other metals, including iron, manganese and lead increase through the treatment system. This may be a temporary condition caused by the leaching of metal hydroxide coatings on the gravel within the cell substrate. However the mining company is evaluating alternatives to reduce this leaching process such as adjusting the soluble organic feed rate in the second cell to manipulate redox conditions within the cell.

Following the three-year treatability test, one of the two pilot scale systems will be selected for the construction of a full-scale treatment system.

The group proceeded to the confluence of Canyon Creek and the South Fork of the Coeur d'Alene for information about the loadings of zinc and lead the creek carries into the river. Next stops were sites above, adjacent to and below the Bunker Hill site. Geoff Harvey discussed how monitoring at these sites quantifies metals loadings into the river. He discussed remediation that has taken place over the last 10 years. Initially, remediation was focused on the area immediately around the Bunker Hill smelter site, "the Box." Now the federal, state and tribal partners have developed a cleanup plan that encompasses the entire Coeur d'Alene Basin, making the site the second largest CERCLA site in the country.

The group moved on to the confluence of the north and south forks of the Coeur d'Alene River. Mr. Harvey discussed the influence of flows from the north fork on the water quality of the combined river.

Finally, at its vantage point from Bull Run Bridge where the river widens into Rose Lake, the committee learned that sand in riverside beaches, some used –despite warning signs- by swimmers, exceeds EPA health-protective standards. Geoff Harvey and Paul Woods discussed efforts to stabilize the banks of the lower river to minimize the remobilization of zinc, lead, and cadmium.

Next Meeting

The next water stakeholder committee meeting is planned for May 21 in Madison, Wisconsin to be held in conjunction with the National Water Monitoring Council's annual conference.